

PARKING PAYMENT (continued)

DERIVED REQUIREMENTS

Communication Mode - Two-way - Beacon above lane.

Transaction Size -- 512 DL/512 UL bits.

Max. No. of Messages -- 5.

Max. Range -- 30 ft.

Communication Zone Size -- 10 ft.

Longitudinal Beacon Separation Distance -- 50 ft (face to face).

Lateral Beacon Separation Distance -- 10 ft.

RENTAL CAR PROCESSING

The rental car processing application allows a vehicle to exit the rental car parking area after being rented and re-enter the parking area where the rental fee is automatically deducted from the driver's charge account or other monetary account. Other beacons are installed so that the rental agency can identify the location of the rental vehicle in the rental lot.

STAKEHOLDER REQUIREMENTS

General Position -- Yes.

Vehicle Detection -- Yes.

Vehicle Location -- Yes.

Lane Discrimination -- Yes.

Communications Performance -- 99.995 %.

Traffic Speed -- 0 to 30 mph.

Traffic Density -- bursts of up to 3000 v/h/l.

Min. Vehicle Separation -- 1 ft.

Min. OBE longitudinal separation -- 16 ft.

Min. OBE lateral separation -- 10 ft.

Beacon Density -- 1 beacon or antenna per entry, exit lane and parking area.

A

RENTAL CAR PROCESSING (continued)

DERIVED REQUIREMENTS

Communication Mode - Two-way - Beacon above lane or parking area.

Transaction Size -- 196 DL/250 UL bits.

Max. No. of Messages -- 5.

Max. Range -- 40 ft at entry and exit / 300 ft in parking area.

Communication Zone Size -- 10 ft.

Longitudinal Beacon Separation Distance -- 50 ft.

Lateral Beacon Separation Distance --10 ft.

A

GAS (FUEL) PAYMENT (CARS)

The gas (fuel) payment application allows a car or light truck to stop beside a fuel pump and have the fuel charge automatically deducted from the driver's charge account or other monetary account. The beacons are installed so that the service station administration can positively identify the location of the vehicle both at the fueling station and at the time of the payment transaction, ensuring that the driver is correctly billed.

STAKEHOLDER REQUIREMENTS

General Position -- Yes.

Vehicle Detection -- Yes.

Vehicle Location -- Yes.

Lane Discrimination -- Yes.

Communications Performance -- 99.995 %.

Traffic Speed -- 0 mph.

Traffic Density -- 10v/h/pump.

Min. Vehicle Separation -- 1 ft.

Min. OBE longitudinal separation -- 6 ft (motor cycles) / **16 ft (other).**

Min. OBE lateral separation -- 3 ft (motor cycles) / 10 ft (other).

Beacon Density -- 1 beacon or antenna per pump.

A

GAS (FUEL)PAYMENT (CARS)

(continued)

DERIVED REQUIREMENTS

Communication Mode - Two-way - Beacon above lane.

Transaction Size -- 512 DL/ 512 UL.

Max. No. of Messages --5.

Max. Range -- 30 ft.

Communication Zone Size -- 20 ft.

Longitudinal Beacon Separation Distance -- 20 ft.

Lateral Beacon Separation Distance --10 ft.

FUEL PAYMENT (TRUCKS/TRANSIT VEHICLES)

The fuel payment application allows a heavy truck or transit vehicle to stop beside a fuel pump and have the fuel charge automatically deducted from the driver's or company's charge account or other monetary account. The beacons are installed so that the service station administration can positively identify the location of the vehicle both at the fueling station and at the time of the payment transaction, ensuring that the driver is correctly billed.

STAKEHOLDER REQUIREMENTS

General Position -- Yes.

Vehicle Detection -- Yes.

Vehicle Location -- Yes.

Lane Discrimination -- Yes.

Communications Performance -- 99.995 %.

Traffic Speed -- 0 mph.

Traffic Density -- 10 v/h/pump.

Min. Vehicle Separation -- 1 ft.

Min. OBE longitudinal separation -- 30 ft (other).

Min. OBE lateral separation -- 10 ft (other).

Beacon Density -- 1 beacon or antenna per pump.

A

FUEL PAYMENT (TRUCKS /TRANSIT VEHICLES)

(continued)

DERIVED REQUIREMENTS

Communication Mode - Two-way - Beacon above Fueling Station.

Transaction Size -- 512 DL/ 512 UL.

Max. No. of Messages -- 5.

Max. Range -- 40 ft.

Communication Zone Size -- 20 ft.

Longitudinal Beacon Separation Distance -- 50 ft.

Lateral Beacon Separation Distance -- 10 ft.

FAST FOOD PAYMENT

The fast food payment application allows a car or light truck to stop beside a service window and have the food charge automatically deducted from the driver's charge account or other monetary account. The beacons are installed so that the restaurant administration can positively identify the location of the vehicle at the time of the payment transaction, ensuring that the driver is correctly billed.

STAKEHOLDER REQUIREMENTS

General Position -- Yes.

Vehicle Detection -- Yes.

Vehicle Location -- Yes.

Lane Discrimination -- Yes.

Communications Performance -- 99.995 %.

Traffic Speed -- 0 mph.

Traffic Density -- 10 v/h/station.

Min. Vehicle Separation -- 1 ft.

Min. OBE longitudinal separation -- 16 ft.

Min. OBE lateral separation -- 10 ft.

Beacon Density -- 1 beacon or antenna per window.

A

FAST FOOD (QSR) PAYMENT (continued)

DERIVED REQUIREMENTS

Communication Mode - Two-way - Beacon above lane.

Transaction Size -- 1024 DL/ 1024 UL.

Max. No. of Messages -- 5.

Max. Range -- 40 ft.

Communication Zone Size -- 20 ft.

Longitudinal Beacon Separation Distance -- 30 ft.

Lateral Beacon Separation Distance -- 10 ft.

A

PHARMACY DRIVE-THRU PAYMENT

The pharmacy drive-thru payment application allows a car or light truck to stop beside a service window and have the product charge automatically deducted from the driver's charge account or other monetary account. The beacons are installed so that the pharmacy administration can positively identify the location of the vehicle at the time of the payment transaction, ensuring that the driver is correctly billed.

STAKEHOLDER REQUIREMENTS

General Position -- Yes.

Vehicle Detection -- Yes.

Vehicle Location -- Yes.

Lane Discrimination -- Yes.

Communications Performance -- 99.995 %.

Traffic Speed -- 0 mph.

Traffic Density -- 10 v/h/station.

Min. Vehicle Separation -- 1 ft.

Min. OBE longitudinal separation --??.

Min. OBE lateral separation -- N/A.

Beacon Density -- 1 beacon or antenna per window.

A

PHARMACY DRIVE-THRU PAYMENT (continued)

DERIVED REQUIREMENTS

Communication Mode - Two-way - Beacon above lane.

Transaction Size -- 1024 DL/ 1024 UL.

Max. No. of Messages -- 5.

Max. Range -- 40 ft.

Communication Zone Size -- 20 ft.

Longitudinal Beacon Separation Distance -- ?? ft.

Lateral Beacon Separation Distance -- 10 ft.

A

TRANSIT VEHICLE DATA TRANSFER (Garage)

Transit vehicle data transfer is accomplished where beacons are positioned at parking places in the transit vehicle garage and communications are initiated with OBE-equipped vehicles at the beginning and end of the day. The transit authority can use this information to accurately monitor vehicle ridership, monitor vehicle fault indicators, and provide route and operational instructions to drivers.

STAKEHOLDER REQUIREMENTS

General Position -- Yes.

Vehicle Detection -- Yes.

Vehicle Location -- No.

Lane Discrimination -- No.

Communications Performance -- 99.995 %.

Traffic Speed -- 0 mph.

Traffic Density -- 250 per garage.

Min. Vehicle Separation -- 1 ft.

Min. OBE longitudinal separation -- 30 ft .

Min. OBE lateral separation -- 10 ft.

Beacon Density -- 1 to 10 per installation.

A

TRANSIT VEHICLE DATA TRANSFER (Garage, continued)

DERIVED REQUIREMENTS

Communication Mode - Two-way - Beacon on Roadside.

Transaction Size -- 512 bits to ≤ 5 megabits.

Max. No. of Messages -- limited by transaction size .

Max. Range -- 500 ft.

Communication Zone Size -- 500 ft.

Beacon Separation Distance --200 ft.

TRANSIT VEHICLE DATA TRANSFER (Garage Gate)

Transit vehicle data transfer at the garage gate is implemented by installing beacons at the entry and exit points to the transit vehicle garage. Communications are initiated with OBE-equipped vehicles at the beginning and end of the day. The transit authority can use this opportunity to confirm the bus, driver, and route assignment; provide last minute transit schedule changes; operational instructions or changes to drivers on the way out; and account for transit vehicles that have returned to the garage.

STAKEHOLDER REQUIREMENTS

General Position -- Yes.

Vehicle Detection -- Yes.

Vehicle Location -- Yes.

Lane Discrimination -- No.

Communications Performance -- 99.995 %.

Traffic Speed -- 20 mph.

Traffic Density -- 250 per garage.

Min. Vehicle Separation -- 1 ft.

Min. OBE longitudinal separation -- 45 ft .

Min. OBE lateral separation -- 10 ft.

Beacon Density -- 1 to 10 per installation.

A

TRANSIT VEHICLE DATA TRANSFER (Garage Gate, continued)

DERIVED REQUIREMENTS

Communication Mode - Two-way - Beacon on Roadside.

Transaction Size -- 512 bits to 2 Megabits.

Max. No. of Messages -- limited by transaction size .

Max. Range -- 120 ft.

Communication Zone Size -- 45 ft.

Beacon Separation Distance -- 20 ft.

DRIVER'S DAILY LOG

The driver's daily log is a collection of data in the OBE that includes the location and times of beacon communications as well as some identification data. The daily log can be read by a hand-held or permanently mounted reader while it has been pulled off the highway at a fixed or mobile inspection site or at the fleet service yard.

STAKEHOLDER REQUIREMENTS

General Position -- Yes.

Vehicle Detection -- Yes.

Vehicle Location -- Yes.

Lane Discrimination -- Yes.

Communications Performance -- 99.995 %.

Traffic Speed -- 0 mph.

Traffic Density -- 1 vehicle until done.

Min. Vehicle Separation -- 1 ft.

Min. OBE longitudinal separation -- 30 ft.

Min. OBE lateral separation -- 10 ft.

Beacon Density -- 10 per installation.

DRIVER'S DAILY LOG

(continued)

DERIVED REQUIREMENTS

Communication Mode - Two-way - Beacon on Roadside or Handheld.

Transaction Size -- 80 DL/2000 UL bits.

Max. No. of Messages -- 5.

Max. Range -- 50 ft.

Communication Zone Size -- 45 ft.

Longitudinal Beacon Separation Distance -- 600 ft.

Lateral Beacon Separation Distance -- 10 ft.

VEHICLE SAFETY INSPECTION

The safety inspection is a check of the safety characteristics of a commercial vehicle while it has been pulled off the highway at a fixed or mobile inspection site. A handheld DSRC reader can be used to speed the inspection process because it does not require a physical connection to the vehicle, and it can transfer registration data, previous inspection data, and on-board sensor data at high transfer rates. Other equipment will also be used to measure the condition of the inspected vehicle.

Data will also be uploaded to the vehicle after the inspection, and in-vehicle signing technology may be used to instruct the driver to proceed or to notify the driver that the vehicle is to be considered out of service.

A

VEHICLE SAFETY INSPECTION (continued)

STAKEHOLDER REQUIREMENTS

General Position -- Yes.

Vehicle Detection -- Yes.

Vehicle Location -- Yes.

Lane Discrimination -- Yes.

Communications Performance -- 99.995 %.

Traffic Speed -- 0 mph.

Traffic Density -- 1 vehicle until done.

Min. Vehicle Separation -- 1 ft.

Min. OBE longitudinal separation -- 30 ft.

Min. OBE lateral separation -- 10 ft.

Beacon Density -- 1 per inspection.

VEHICLE SAFETY INSPECTION (continued)

DERIVED REQUIREMENTS

Communication Mode - Two-way - Beacon on Roadside or Handheld.

Transaction Size -- 80 DL/2000 UL bits.

Max. No. of Messages -- 10.

Max. Range -- 50 ft.

Communication Zone Size -- 20 ft.

Longitudinal Beacon Separation Distance -- 600 ft.

Lateral Beacon Separation Distance -- 10 ft.

REPAIR SERVICE RECORD and DATA TRANSFER

A handheld or garage mounted DSRC reader can be used to speed the repair process because it does not require a physical connection to the vehicle, and it can transfer registration data, previous repair data, new engine and electronics control programs, map databases, and on-board sensor data at high transfer rates. Other equipment will also be used to measure the condition of the vehicle for repair. After the repair the data will be uploaded to the vehicle.

STAKEHOLDER REQUIREMENTS

General Position -- Yes.

Vehicle Detection -- Yes.

Vehicle Location -- Yes.

Lane Discrimination -- Yes.

Communications Performance -- 99.995 %.

Traffic Speed -- 0 mph.

Traffic Density -- 1 vehicle until done.

Min. Vehicle Separation -- 1 ft.

Min. OBE longitudinal separation -- 30 ft.

Min. OBE lateral separation -- 10 ft.

Beacon Density -- 1 per inspection.

A

REPAIR SERVICE RECORD and DATA TRANSFER (continued)

DERIVED REQUIREMENTS

Communication Mode - Two-way - Beacon on Shop Mounted or Handheld.

Transaction Size -- 80 DL/4000 UL bits (repair service record).

Transaction Size -- 80 Mbits (10 Mbytes) (miscellaneous data).

Max. No. of Messages -- 20.

Max. Range -- 50 ft.

Communication Zone Size -- 20 ft.

Longitudinal Beacon Separation Distance -- 50 ft.

Lateral Beacon Separation Distance -- 10 ft

RAIL ENGINE DATA TRANSFER

Rail engine data transfer is accomplished where beacons are positioned in the departure and forwarding yard and at the entrance and exit of the yard. Communications are initiated with OBE to download the train control database and upload the event and health recorder data.

STAKEHOLDER REQUIREMENTS

General Position -- Yes.

Vehicle Detection -- Yes.

Vehicle Location -- No.

Lane Discrimination -- No.

Communications Performance -- 10^{-6} message error rate

Traffic Speed -- 0 mph.

Traffic Density -- 10 per yard.

Min. Vehicle Separation -- 20 ft.

Min. OBE longitudinal separation -- 2000 ft .

Min. OBE lateral separation -- 20 ft.

Beacon Density -- 1 to 10 per installation.

A

RAIL ENGINE DATA TRANSFER (continued)

DERIVED REQUIREMENTS

Communication Mode - Two-way - Beacon on Roadside.

Transaction Size -- $\leq 80,000$ bits.

Max. No. of Messages -- limited by transaction size .

Max. Range -- 3000 ft.

Communication Zone Size -- 2950 ft.

Beacon Separation Distance --3000 ft.

RAIL ENGINE FUELING CONTROL

The rail engine fueling control application monitors the fuel level in the engine as it is being filled. The OBE sends messages to the rail side beacon listing the fuel status and commanding automatic cutoff when the engine is full.

STAKEHOLDER REQUIREMENTS

General Position -- Yes.

Vehicle Detection -- Yes.

Vehicle Location -- Yes.

Track Discrimination -- Yes.

Communications Performance -- 10^{-6} message error rate

Engine Speed -- 0.

Engine Density -- 1 engine.

Engine Separation -- ??.

Min. OBE longitudinal separation -- 50 ft.

Min. OBE lateral separation -- ??.

Beacon Density -- 1 beacon or antenna per engine.

RAIL ENGINE FUELING CONTROL (continued)

DERIVED REQUIREMENTS

Communication Mode - Two-way - Beacon at Rail side.

Transaction Size -- ??? bits.

Max. No. of Messages -- limited by fuel monitored.

Max. Range -- 40 ft.

Communication Zone Size -- 10 ft.

Longitudinal Beacon Separation Distance -- 50 ft.

Lateral Beacon Separation Distance -- ?? ft.

TRUCK TRACTOR-TRAILER SAE DATA BUS INTERFACE

The truck tractor-trailer interface is an RF extension of the 51939 bus between a connected tractor and trailer. It is implemented with a beacon antenna mounted on the frame, behind the fifth wheel pointing upwards, and the trailer's mounted on the underside of the trailer pointing down. The distance between the antennas would then be normally about 3 feet or less, but could extend to 10 feet during extreme turns (such as when backing into parking spaces). This system could be used to implement cargo monitoring, tire pressure monitoring, stability control, and electronic braking.

STAKEHOLDER REQUIREMENTS

Transfer data between the tractor's 51939 interface and the connected trailer's 51939 interface at speeds from 250 kbps to more than 500 kbps.

General Position -- N/A.

Vehicle Detection -- N/A.

Vehicle Location -- N/A.

Lane Discrimination -- N/A.

Communications Performance -- 10^{-7} message error rate.

TRUCK TRACTOR-TRAILER SAE DATA BUS INTERFACE (continued)

STAKEHOLDER REQUIREMENTS (continued)

Traffic Speed -- N/A.

Traffic Density -- N/A.

Min. Vehicle Separation -- 1 ft.

Min. OBE longitudinal separation -- 30 ft (with a tractor in between).

Min. OBE lateral separation -- 8 ft.

Beacon Density -- 1 per tractor.

DERIVED REQUIREMENTS

Communication Mode - Two-way - Beacon on Tractor behind fifth wheel.

Transaction Size -- unlimited.

Max. No. of Messages -- unlimited .

Max. Range -- 10 ft.

Communication Zone Size -- 10 ft.

Beacon Separation Distance -- 8 ft.

ELECTRONIC LICENSE PLATE

The electronic license plate (ELP) application allows an enforcement agency to check the license plate number, state and expiration date, contained in a OBE's memory when the OBE is built into a standard size license plate. This application could reduce the time required to obtain queries on vehicles about to be stopped and allow traffic to be screened for stolen or unlicensed vehicles.

STAKEHOLDER REQUIREMENTS

General Position -- Yes.

Vehicle Detection -- Yes.

Vehicle Location -- Yes.

Lane Discrimination -- Yes.

Communications Performance -- 99.995 %.

Traffic Speed -- 120 mph.

Traffic Density -- 3000 v/h/1.

Min. Vehicle Separation -- 1 ft.

Min. OBE longitudinal separation -- 16 ft.

Min. OBE lateral separation -- 10 ft.

Lateral Density -- 1 per police car and 50 portable roadside monitors per jurisdiction.

A

ELECTRONIC LICENSE PLATE (continued)

DERIVED REQUIREMENTS

Communication Mode - Two-way - Beacon in the grill of the police car.

Transaction Size -- 196 DL/250 UL bits.

Max. Packet Size of a Single Message -- 256 bits.

Max. No. of Messages -- 5.

Max. Range -- 150 ft.

Communication Zone Size -- 120 ft.

Longitudinal Beacon Separation Distance -- 1000 ft.

Lateral Beacon Separation Distance -- 10 ft.

5.9 GHz DSRC APPLICATION CATEGORIES

- TRAFFIC MANAGEMENT
 - PROBE DATA COLLECTION
 - TRAFFIC INFORMATION
 - IN-VEHICLE SIGNING
 - WORK ZONE SAFETY WARNING
 - ROLLOVER WARNING
- TRAFFIC SIGNAL INTERFACE
 - EMERGENCY VEHICLE SIGNAL PREEMPTION
 - TRANSIT VEHICLE SIGNAL PRIORITY
 - INTERSECTION COLLISION AVOIDANCE
 - HIGHWAY/RAIL INTERSECTION WARNING
- ACCESS POINT OPERATIONS
 - ACCESS CONTROL
 - VEHICLE AND CARGO TRACKING
- CVO MAINLINE OPERATIONS
 - (VEHICLE AND CARGO TRACKING)
 - WEIGH-STATION CLEARANCE
 - INTERNATIONAL BORDER CLEARANCE
 - ON-BOARD SAFETY DATA
 - UNIQUE CVO FLEET MANAGEMENT
- ELECTRONIC PAYMENT (In-motion)
 - TOLL COLLECTION
 - PARKING PAYMENT
 - RENTAL CAR PROCESSING
- ELECTRONIC PAYMENT (Stationary)
 - GAS (FUEL) PAYMENT
 - FAST FOOD (QSR) PAYMENT
 - PHARMACY DRIVE-THRU PAYMENT
- DATA TRANSFER (Stationary)
 - TRANSIT VEHICLE DATA TRANSFER
 - DRIVER'S DAILY LOG
 - VEHICLE SAFETY INSPECTION
 - REPAIR-SERVICE RECORD and DATA TRANSFER
 - RAIL ENGINE DATA TRANSFER
 - RAIL ENGINE FUELING CONTROL
- MOBILE OR STATIONARY INTERFACE
 - ELECTRONIC LICENSE PLATE
 - TRUCK TRACTOR-TRAILER INTERFACE